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Biological activities of some plant materials against the housefly – *Musca domestica*.

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ABSTRACT: The seed of *Peganum harmala* and leaves of *Acalypha indica, Carica papaya, Santalum album* and *Calotropis gigantica* were screened for biological activity against the larval-pupal and pupal-adult transformation stages of the housefly *Musca domestica*. All the plant materials screened, except *Carica papaya,* prolonged the life of larvae, hindered larval-pupal transformation and reduced pupal weight considerably. Eclosion of the pupae was also hindered to varying extents by all the plants tested. The plants were rated in order of efficacy and the likelihood of the occurrence of desirable principles in the plant materials for housefly management is discussed.

Key Words: Housefly; *Musca domestica*; Insect control; Plant extracts.

Introduction

The order Dipetra presents an array of insects which more than any other group poses the greatest challenge to human and veterinary health as vectors of diseases. One such insects, which share a close ecological niche with man is the housefly, *Musca domestica*. Apart from disease transmission, *M. domestica* soils man's food and usually constitutes a nuisance, particularly the adult stage. They, however, have desirable features which include the use of the immature stages as protein supplement in animal feed (1), scavenging and recycling of organic wastes. This holometabolous insect with a scavenging and desirable larval stage, but a disease transmitting adult stage, requires a management strategy which selectively encourages the larval stage and discourages its development to imago. Some plants harbour insect juvenile and moulting hormones or anti hormones (2-4) which could be useful as an agent for achieving this strategy. Ahmed et al. (5) reported prolonged larval duration, incomplete emergence, deformity and death of resulting imago from maggots fed with *Peganum harmala* seeds; one of the plants listed by Secoy and Smith (6) as used in the control of lice and mosquitoes. *Acalypha indica*, *Carica papaya, Santalum album* and *Calotropis gigantica* have also been used in the control of mosquitoes (6), but their biological activity against the housefly has not been reported. This study attempts to confirm the reported activities of *P. harmala* and screen other plants for similar activities.

Materials and Methods

Seeds of *P. harmala* and leaves of *A. indica* (Euphorbiaceae), *Carica papaya* (Caricaceae), *S. album* (Santalaceae) and *Calotropis gigantica* (Asciepiadaceae) were collected, air dried in a shade, pulverized and kept in a screw cap brown bottle for use as described subsequently.

Stock third instar housefly larvae were raised from eggs collected from the insectary of the Department of Infestation Control and Insect Protectant at the Centre for Food Technological Research Institute, Mysore, India, on artificial diet composed as follows:

Starch (2.25g), powdered milk (2.25g) and yeast (0.5g) were dissolved completely in 10 cm^3 of distilled water. Crushed paper (5g) was added and mixed thoroughly with additional water to make 2.00 cm^3 per gram of solid constituent. To the test media, additional 2g or 4g of the respective leaf powders were added to make 17% and 28% concentrations, respectively.

Ten third instar larvae picked randomly from the stock sample were introduced into each test tube containing newly prepared tests and control (without plant material) media and subsequently covered with muslin cloth. Four replicates of each treatment were maintained. After 5 days each tube was examined for the condition of the larvae, number of puparia and collective puparial weight. The puparia were returned into the tubes without the substrates and covered up with muslin cloth. Each tube was subsequently inspected for adult emergence status after 1 week. Intact puparia were opened up to see if pupa was actually formed. The data obtained were subjected to statistical analysis using the Analysis of Variance (ANOVA).

Results

Prolonged larval duration were noticed with *P. harmala, A. indica* and *Calotropis gigantica. Calotropis gigantica* gave the highest larval retention activity and it increased with leaf extract concentration while the other two plants lost their larvae retention activity with increased leaf extract concentration (Table 1). All the plants tested, except *Carica papaya*, recorded lower pupariation rate than the control (Table 1), all of which were below 40%. Seventeen percent of *P. harmala* gave a significantly lower ($P < 0.05$) pupariation rate than *A. indica* and *S. album* whose activities were comparable. Pupariation rates reduced drastically with higher leaf concentration except with *P. harmala* where it remained the same and with *S. album* where the pupariation rate increased. Larvae raised on *P. harmala* diets recorded a significantly lower pupal average weight (1.67 mg), while those raised in *A. indica* and *Calotropis gigantica* diets gave pupal weights comparable with control experiment (8.00 mg and 10.36 mg respectively). Pupae obtained from *Carica papaya* and *S. album* treatments had significantly higher average weights of 14.80 mg and 12.70 mg respectively (Table 1). The average pupal weights dropped with increased leaf concentration.

Successful or complete adult emergence rates were consistently lower with all plant based diets than with control experiment at leaf concentration of 17% (Table 2). Whereas *A. indica* and *P. harmala* did not allow imago eclosion at the higher leaf concentration, *calotropis gigantica* and *S. album* recorded an improved eclosion success rate compared to the control. In all the treatment cases the adult could not free itself from the puparia, while it successfully freed itself in the control experiment. Pupae did not develop in most of the puparia treated with *Calotropis gigantica*, an indication that they died immediately after formation (Table 2).

Discussion

P. harmala powder prolonged the larval duration, hindered larval/pupal transformation and incomplete emergence of imago from puparia as reported by Ahmed et al. (5). At a higher dose, however, *P. harmala* showed larvicidal and pupaecidal activities, thus suggesting that the plant material loses its desirable activities with increasing concentration. *A. indica* showed similar but milder activities, even at 28% concentration. In respect of prolonged larval duration and pupariation rate, four plants showed some activity and they are rated as follows:

P. harmala > *A. indica* > *Calotropis gigantica* > *S. album*

Carica papaya enhaned larval growth and encouraged pupariation both of which are not desirable activities with respect to housefly control

Eclosion of puparia was hindered to varying extents by each of all the plant materials tested. *A. indica* was particularly promising as the possibility of hindering eclosion completely like *P. harmala* was evident. The plant materials rated as follows with respect to their efficacy at hindering eclosion process in pupae:

P. harmala > *A. incica* > *Carica papaya* > *S. album* > *Calotropis gigantica*

Table 1: Pupariation rates and weights of pupa formed from third instar larvae raised on different diets.

Test diet	Concen-tration (%)	Mean larval retention rate (%)*	Mean pupariation rate (%)	Mean total weight of pupa (mg)	Average weiht of pupa (mg)
Control	0	Nil	70.00e	80.00	8.00b
A. indica	17	3.33	40.00b	41.33	10.36b
	28	Nil	3.33	1.53	1.53
Carica papaya	17	Nil	83.33d	123.33	14.80c
	28	Nil	33.33	26.67	14.00
Calotropis gigantica	17	6.67	33.33b	26.67	8.00b
	28	20.00	10.00	8.00	8.00
S. album	17	Nil	36.67b	46.66	12.7c
	28	Nil	43.33	56.66	13.08
P. harmala	17	3.33	3.33a	1.67	1.67a
	28	Nil	3.33	1.53	1.53

*Living larvae observed after five days of feeding. All values are means of four replicates. Values followed by the same alphabet along the columns are not significantly different ($P < 0.05$).

A compounded diet of housefly containing these plant materials no doubt contains desirable primary or secondary principles which may have developed from the interactions of the components of the diet. These principles elicit biological activities in respect of larval/pupal transformation and pupal eclosion hindrances and they could be useful in the formulation of a desirable housefly management strategy.

Table 2: Adult emergence pattern of pupae of third instar larvae raised on various test diets.

Treatment	Concentration (%)	Emergence Status			No pupa in puparia (%)
		Complete (%)	Incomplete (%)	No emergence (%)	
Control	0	76.19	0.00	23.81	0.00
A. indica	17	64.44	16.67	18.89	0.00
	28	0.00	100.00	0.00	0.00
Carica papaya	17	52.00	16.00	24.00	8.00
	28	88.00	4.00	8.00	0.00
Calotropis gigantica	17	54.55	9.09	18.18	18.18
	28	85.71	0.00	0.00	14.28
S. album	17	54.55	9.09	36.37	0.00
	28	86.61	7.69	7.69	0.00
P. harmala	17	0.00	0.00	0.00	100.00
	28	0.00	100.00	0.00	0.00

All values are means of four replicates.

References

1. El Boushy, A. R. (1991) Housefly pupae as poultry manure converters for animal feed: A review. Bioresource technology 38, 45 – 49.
2. Morgan, E. D. (1980) Strategy in the isolation of insect control substrates from plants. Proc. 1st Int. Neem Conf. Rottach-Egern. pp. 43 – 52.
3. Olaifa, J. J.; Erhun, W. O. and Akingbohungbe, A. E. (1987) Insecticidal activity of some Nigerian plants. *Insect Science and Its Application* 8(2), 221 – 224.
4. Schmutterer, H. (1990) Properties and potential of natural pesticides from the neem tree *Azadirachta indica*. Ann, Rev. Entomol. 35, 271 – 297.
5. Ahmed, S. M.; Chandler, H. and Pereira, J. (1981) Insecticidal potentials and biological activity of Indian indigenous plants against *Musca domestica* L. Int. Pest Control 23(6), 170 – 175.
6. Secoy, D. M. and Smith, A. E. (1983) Use of plants in control of agricultural and domestic pests. Economic Botany 37(1), 28 – 57.
7. Trumman, J. W. and Riddiford, L. M. (1970) Neuroscience control of ecdysis in silkmoths. Science 167, 624 – 1626.
8. Highman, C. K. and Hill, H. (1978) The comparative endocrinology of the invertebrates. Edward Arnold Publishers Ltd., London. 2nd Edition, p. 357.
9. Truman, J. W. (1971) Physiology of insect ecdysis: The eclosion behaviour of saturniid moths and its hormonal release. J. Exp. Biol. 54, 805 – 814.